The Legume Family: Resources and Research

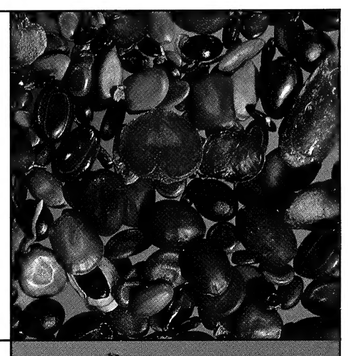
The Missouri Botanical Garden, St. Louis



The Legume Family: Fabaceae (Leguminosae) is the third largest plant family, ranking only behind the orchid and sunflower families in number of species. The three subfamilies (Caesalpinioideae, Mimosoideae, and Faboideae) together contain some 650 genera and approximately 18,000 species, which are distributed on all continents except Antarctica. Economically, legumes are second only to grasses in importance. Familiar legumes include peanuts, soybeans, peas, common beans, lentils, pigeon peas, chickpeas, cowpeas, broadbeans, mung beans, alfalfa, clover, and vetches. In addition to these well-known useful legumes, others are important sources of timber and firewood. Many are spectacular ornamental plants, and still others provide people with edible fruits, pulses, root crops, gums, resins and chemicals. A species of *Mucuna* is pictured on the left (AHG).



Characteristic Fruits and Seeds: Most members of this family have similar fruits, a kind of pod called a *legume*, which splits into two halves, or valves. The fruits, which are characteristic of different members of the family, vary remarkably in size and shape, as well as in their appendages and adornments. An open fruit of *Erythrina edulis*, from South America, is pictured at the left (AHG), and seeds of representative species in the subfamily Mimosoideae are shown at the right (CRG).





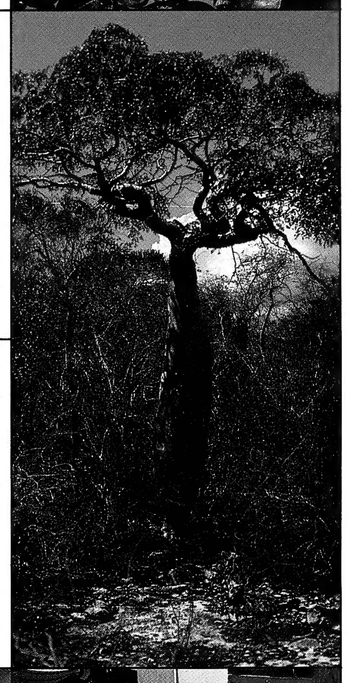
Habitats: Legumes are found throughout the world, from arctic regions to the tropics. *Lupinus mutabilis*, a kind of lupine, occurs at high elevations in the Andean alpine of South America (left, CBH). Legumes are able to inhabit even barren terrain. This *Erythrina* species (right, GD) inhabits the dry savannas of Kenya. Legume trees and shrubs are valuable resources in savannas—open tropical grasslands—where they provide badly-needed forage for livestock, as well as firewood and sometimes food.

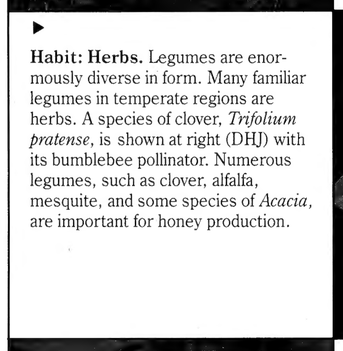




Legumes of the Tropics: Most species of legumes occur in the tropics, where many of them are conspicuous components of tropical forests. Tropical legumes also often dominate areas with poor soil or extreme drought. The silvery foliage of *Tachigali cavipes* (left, JLZ) is seen in this photograph of a tropical riverine forest in the northwestern Amazon Basin of Colombia.

The swollen trunk of *Delonix adansonioides* (right, LJD) is a striking feature of the dry areas of Madagascar. More than 500 species of legumes are known from this island; most are found nowhere else. The vegetation of Madagascar is one of the most endangered in the world, with more than 90 percent of the country's original forests having been destroyed.





Habit: Herbs. Legumes are enormously diverse in form. Many familiar legumes in temperate regions are herbs. A species of clover, *Trifolium pratense*, is shown at right (DHJ) with its bumblebee pollinator. Numerous legumes, such as clover, alfalfa, mesquite, and some species of *Acacia*, are important for honey production.





Habit: Shrubs. *Acacia pycnantha* (left, JK), the golden wattle, is the national flower of Australia. Golden wattle, a shrub, has numerous branches from the base; whereas in trees, there is a single, well-defined trunk. Many shrubs and trees of this family are popular ornamentals, mainly in tropical and subtropical regions.



Habit: Trees. Many legume species are trees reaching gigantic proportions. Legume trees are especially important ecologically because they often are fast-growing and can thrive on poor soils. Hence, many are the first species to colonize newly-cleared land or other marginal habitats. Buttresses of the legume *Pterocarpus officinalis*, (left, DHJ) in the tropical forests of Costa Rica, help support the enormous trunk and crown of this tree.

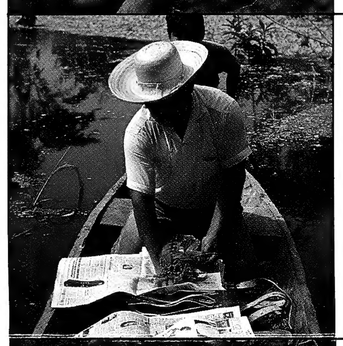


Soil Fertility: Nitrogen is an essential component of proteins, which form part of the bodies of all plants, animals and microorganisms and are essential for life. Animals obtain all of their nitrogen from plants. Nodules on the roots of many legume species house nitrogen-fixing *Rhizobium* bacteria. These bacteria are among the few kinds of organisms that can take gaseous nitrogen from the atmosphere and convert it into nitrogenous compounds. Most non-legumes must obtain their nitrogen from the soil, where it is often very scarce. Since many legumes manufacture their own nitrogen-containing compounds from the air, they are able to grow in areas where the supply of nitrogen in the soil is especially poor, and compete well where most other plants would fail. Two of the many important nitrogen-fixing leguminous crop plants include the bean, *Phaseolus vulgaris* (left, DHJ) and soybean, *Glycine max* (right, RE).

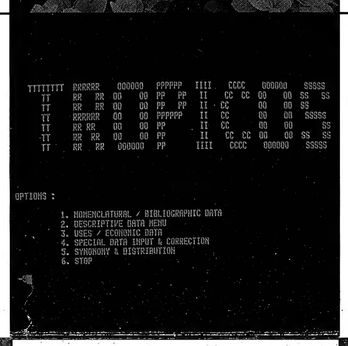


Economic Plants—Crops: Enriching the soil with nitrogen, legumes such as alfalfa (*Medicago sativa*, right, DMG) are often rotated with other crops. The common bean (*Phaseolus vulgaris*) is a single species with over 14,000 different cultivated races, including pinto beans, stringbeans, kidney beans, navy beans, and black beans (far right, CBH). In their nutritious seeds ("beans"), protein levels are very high, ranging from 5.9 to 22.5 percent.



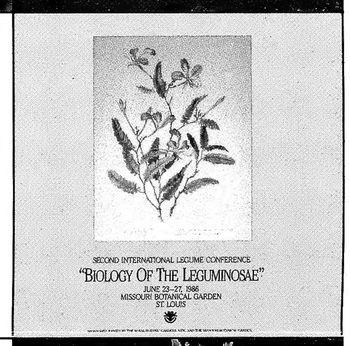


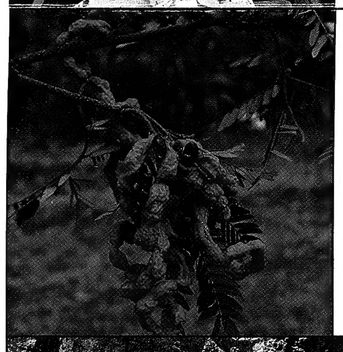
Missouri Botanical Garden Research: Exploring, collecting specimens (left, JLZ) and compiling inventories of the plants of specific areas—floras—are the first steps in studying the plant species of any particular region of the world. The research program at the Missouri Botanical Garden focuses on the tropics, where approximately two thirds of all plant and animal species live. The Garden's research effort is carried out by about 25 Ph.D.-level scientists (many of whom live in tropical countries), technical staff, and graduate students, all dedicated to exploration and the study of tropical plants. Some 80,000 plant specimens are added to the Missouri Botanical Garden's collection each year.



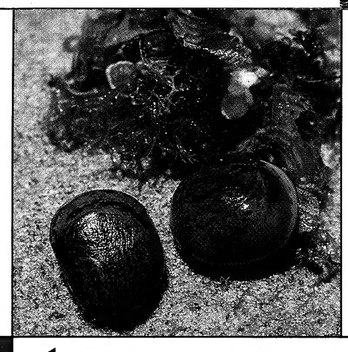
Legume Database: The TROPICOS computerized database (left, JLZ) at the Missouri Botanical Garden includes information on legumes, emphasizing the members of the family that occur in the New World tropics and subtropics. Capturing these data on legumes will allow new precision in scientific understanding of the group, including such aspects as patterns of distribution, relationships, and new economic uses. The Garden's Legume Database Project is also a key element in the International Legume Database and Information Service (ILDIS) effort.

The Second International Legume Conference, sponsored jointly by the Royal Botanic Gardens, Kew, and the Missouri Botanical Garden, was held 23-27 June 1986 in St. Louis. Its theme was the "Biology of the Leguminosae" (right, CK).

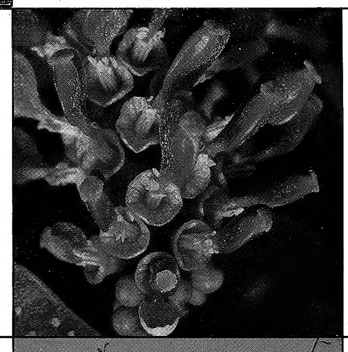




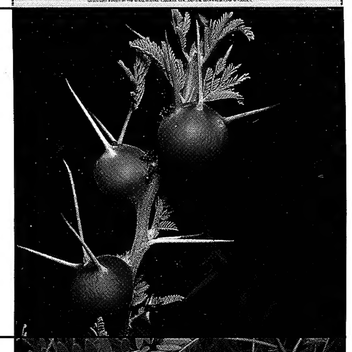
Seed Dispersal: Since plants are stationary organisms, they usually must depend on outside agents for the dispersal of their seeds and fruits. The brightly-colored mature fruits of this Central American species of *Pithecellobium*, (left, TBC), attract the attention of the birds and mammals that carry the seeds and fruits to new areas. Other legumes depend on wind and water to transport their seeds. The seeds of *Dioclea reflexa*, (right, CRG), are dispersed by ocean currents.



Pollination: Most legumes depend upon insects for pollination of their flowers; some depend on birds, such as hummingbirds; and a few tropical groups depend on flower-visiting bats. Color, fragrance, and form are features that have evolved to attract specific kinds of animals. In a few legumes, such as *Ateleia herbert-smithii*, in Costa Rica (right, DHJ), wind carries the pollen from flower to flower.



Plant-Animal Interactions: Certain specific kinds of ants inhabit the swollen thorns of a few species of *Acacia*, both in Africa and in Latin America. The acacias provide shelter and food for the ants, driving leaf-eating insects and other animals away from their host trees, cutting away the branches of other plants that come into contact with them. The swollen thorns of *Acacia drepanolobium* (right, DHJ), shown here in Kenya, illustrate this phenomenon.

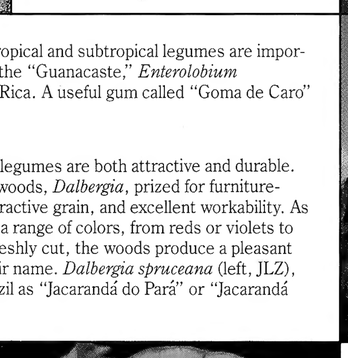




Economic Plants—Timber: Many tropical and subtropical legumes are important sources of timber. One of these is the "Guanacaste," *Enterolobium cyclocarpum* (far left, DHJ) from Costa Rica. A useful gum called "Goma de Caro" is also obtained from the same tree.

Woods of many tropical and subtropical legumes are both attractive and durable. The most famous of these are the rosewoods, *Dalbergia*, prized for furniture-making because of their rich colors, attractive grain, and excellent workability. As a group, the various rosewoods exhibit a range of colors, from reds or violets to chocolate browns and yellows. When freshly cut, the woods produce a pleasant rose-like scent, which accounts for their name. *Dalbergia spruceana* (left, JLZ), an Amazonian species, is known in Brazil as "Jacarandá do Pará" or "Jacarandá preto."





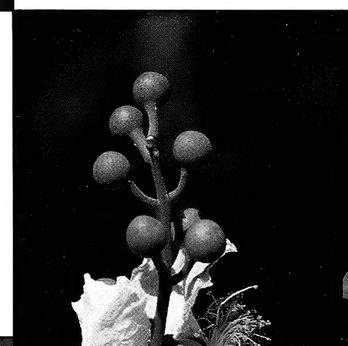
Economic Plants—Chemicals: *Lonchocarpus utilis* (left, TCP) is known locally as "Kube" in Peru, where the plant is cultivated. Its roots are gathered as a source of the chemical rotenone, an important insecticide. For centuries, indigenous peoples have used this plant and related species of legumes as fish poisons.

The notorious "locoweeds" (right, EWD) are members of the genus *Astragalus* and contain chemicals that are dangerous to livestock.



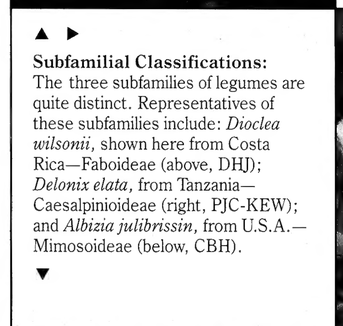


Evolutionary Puzzles: *Swartzia polyphylla* (right, JLZ) is a widespread Amazonian tree legume. As an example of our former lack of knowledge, new studies of the morphology, anatomy and chemistry of the tribe Swartzieae show that this species is a member of the subfamily Faboideae, not the Caesalpinioideae.

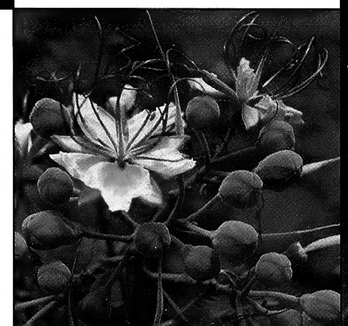


Subfamily Faboideae (or Papilionoideae) have flowers that resemble those of the common pea. Examples of this group include *Crotalaria capensis* from southern Africa (left, RZ-KEW); *Tetragonolobus requienii* (right, GPL-KEW) of the Mediterranean region; and *Hardenbergia violacea* (far right, GPL-KEW) a vine from Australia which is occasionally cultivated.





Subfamilial Classifications: The three subfamilies of legumes are quite distinct. Representatives of these subfamilies include: *Dioclea wilsonii*, shown here from Costa Rica—Faboideae (above, DHJ); *Delonix elata*, from Tanzania—Caesalpinioideae (right, PJC-KEW); and *Albizia julibrissin*, from U.S.A.—Mimosoideae (below, CBH).



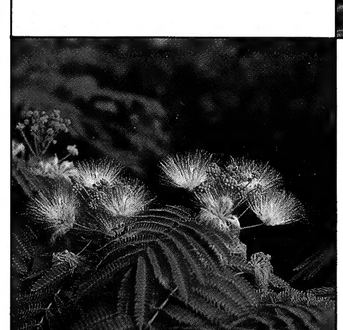




Subfamily Caesalpinioideae: Representative species of the Caesalpinioideae include *Senna bacillaris* (far left, JLZ), a native of northern South America, and *Cercis canadensis* (left, CBH), the well-known, spring-flowering redbud, which enlivens the early spring woods of Missouri. The *Flora of Missouri*, by Julian A. Steyermark, includes some 92 native legume species and an additional 44 introduced species for the state.

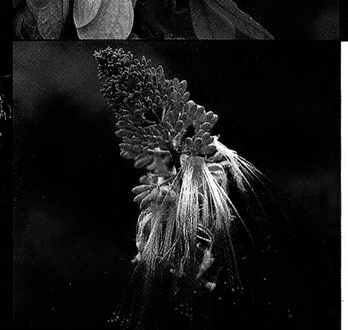






Pithecellobium laetum is a mimosoid legume with showy inflorescences found along the young branches (right, AHG).





Subfamily Mimosoideae: *Calliandra* is found throughout the tropics and subtropics of the world. Examples of this group include *Calliandra calothyrsus* from Central America (left, HH) and *Calliandra haematocephala* of northern Colombia (right, JLZ). The photograph on the far right (HH) shows a species of *Zapoteca*, a genus that was separated from *Calliandra* as a result of research conducted at the Missouri Botanical Garden.



Dedication

The Board of Trustees, Director and Staff of the Missouri Botanical Garden dedicate this poster to the memory of J.P.M. Brenan, former Director of the Royal Botanic Gardens, Kew, England, and long-time researcher on the Legume Family. Pat Brenan's many contributions to our better understanding of tropical plants through his botanical exploration, research, and direction of investigations are fondly remembered.

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